Congressional Notification Profile
DE-PS26-02NT41369

UNIVERSITY COAL RESEARCH PROGRAM, INNOVATIVE CONCEPTS PROGRAM
University of Cincinnati

Background and Technical Information:
Project Title: "Dual-Phase Inorganic Membranes for High Temperature Carbon Dioxide Separation."

The University of Cincinnati will produce and study dense, dual-phase metal-carbonate membranes capable of separating nitrogen from CO_2 in flue gas streams. Metal-carbonate is a new class of inorganic membranes that are generally more energy-efficient and easier to operate than other separation processes. The membranes will be produced with different microstructures at temperatures ranging 350^o to 700^o C at varying pressures.

The CO_2 can be sold as a feedstock for synthetic fuels. Most research in this area has centered on inorganic, zeolite membranes.

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Congressional District: OH 1st and 2nd County: Hamilton

Financial Information:

Length of Contract (months): 36-60
Government Share: $199,377
Total value of contract: $199,377

DOE Funding Breakdown:
Funds: FY 2002 $199,377

Public Abstract

Dual-Phase Inorganic Membranes for High Temperature Carbon Dioxide Separation

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Carbon dioxide is produced in many industrial applications such as electrical generation by burning coal. In many cases it is highly desirable to separate carbon dioxide from industrial gas streams at a high temperature. The high temperature carbon dioxide separation process would produce concentrated, warm carbon dioxide, which can be subsequently used directly as a feedstock for chemical synthesis of fuels (e.g., methanol or chemicals). Membrane process is generally more energy efficient and easier to operate than the other separation processes. Development of membranes with high permeance and selectivity for carbon dioxide at high temperatures is the key to the success of the membrane process for carbon dioxide separation.

Extensive research has been conducted in the past decade on microporous inorganic membranes (in particular zeolite membranes) for carbon dioxide separation. However, the microporous inorganic membranes permselective for carbon dioxide at low temperatures do not offer high selectivity for carbon dioxide at high temperatures. The present project is focused on development of a dense, dual phase metal-carbonate inorganic membrane which is fundamentally different from those porous inorganic membranes studied before. The membrane consists of a highly ionic conducting carbonate imbedded in a metallic phase as the support which provides pathway for electronic conduction and offers physical affinity for the carbonate. The objective of the research conducted in his project is to obtain a dense inorganic membrane with carbon dioxide permeance of $1\text{-}5\times10^{-7}$ mol/m^2.s.Pa and carbon dioxide to nitrogen selectivity over 100 (at 400-600 ^{o}C).

The proposed project is a continuation of Innovative Concept Phase I research sponsored by Department of Energy. The research will be conducted at University of Cincinnati. A synthesis method taking advantage of the unique interfacial properties between the carbonate and metal will be used to prepare the proposed membranes. The feasibility of this synthesis method was verified in the Phase I research. The specific work to be conducted in this project includes selection and characterization of various metal membranes with different pore structure and size, optimization of the synthesis conditions for preparation of hermetic dual-phase membranes, experimental and modeling study of carbon dioxide permeation and separation properties of the dual phase membranes, and investigation of the stability of the membranes. The research conducted in this project will result in a new class of inorganic membranes with high carbon dioxide
permeance and good carbon dioxide to nitrogen selectivity.